

tems extending from the Gulf of Alaska southward to low latitudes off our western coast. So obvious was the trend of conditions to the westward that no hesitation was felt in the issuance of the regular weekly weather outlook on Saturday, February 12, predicting general rains in the far western States with snows in the mountains for the entire week. The day following storm warnings were ordered along the California coast, and warnings were issued to power and transportation interests to prepare for a succession of disturbances accompanied by heavy snows in the Sierra. The situation was so unusual that conservatism was properly abandoned and emergency measures were advocated.

The initial disturbance reached the California coast on February 13 and wet weather prevailed over the greater part of the Pacific Slope from then until the 26th, when the weather cleared and became settled in California, although light rains continued in parts of the North Pacific States. Especially stormy weather prevailed in California from the 13th to the 17th. Warnings were required on some part of the coast during all of this time, and strong winds or gales occurred daily. Exceptionally strong gales occurred during the night of 15th-16th, when a maximum velocity of 76 miles, southeast, was recorded at Point Reyes. The most notable feature, however, of this period was the extraordinary rainfall in southern California, which was unequalled in amount for any similar period since the deluge of January, 1916. Precipitation totals ranged from 5 to 12 inches at a great many observation points, and in some cases even greater amounts were reported. Many bridges were carried away, numerous highways rendered impassable by washouts, and communications variously interrupted. The pressure situation over the adjacent ocean during this time is especially worthy of remark. It was noted above that the Pacific high-pressure system was considerably south of its normal position, with concomitant disturbed weather on the coast north of latitude 35° during the time that this condition prevailed. During the period just mentioned, or more specifically, from the 11th to the 26th, inclusive, this high pressure system was not only far south of its normal position, but for a part of the time, namely, that when the stormiest weather was prevailing in southern California, it disappeared from the area of observation, and there was literally no Pacific HIGH in evidence. The first indication of its reestablishment was on the morning of February 18, and so obvious were the symptoms that special advices were telegraphed to southern California Weather Bureau officials and issued to the press predicting that the period of persistent rainfall was about to terminate, a forecast which was fully verified for the central and southern parts of California, and especially designed to relieve the anxiety which was entertained over a possible continuation of the heavy rains in the extreme southern end of the State, where repairs and rehabilitation were in progress.

The return to higher pressures over the lower latitudes of the ocean was attended by the reappearance of disturbances in the higher latitudes and storm warnings were almost continuously required at north coast ports from the 17th to the 25th, inclusive.—*T. R. Reed.*

#### RIVERS AND FLOODS

By H. C. FRANKENFIELD

*Atlantic drainage.*—A period of rain from February 18 to 23 with local heavy falls on February 19 and 23 caused moderate floods in the basins of the James River of Virginia and in the rivers of the Carolinas. The floods were

of short duration, the usual warnings were issued, and the damage was little or nothing. Property to the value of \$35,000 was reported as having been saved by the warnings. The Santee River of South Carolina was still in flood at the close of the month and did not crest at Ferguson until March 2.

*East Gulf drainage.*—Heavy rains on February 11-12 over the drainage area of the Alabama River caused a rapid rise in all rivers of that district, that in the upper reaches of the Alabama River being accentuated by the closing of many of the gates at Lock No. 12 and Mitchell Dam on the Coosa River. From 8 a. m., February 13, to 8 a. m., February 14, the rise in the Coosa River at Wetumpka, Ala., was 37.6 feet, and that in the Alabama River at Montgomery, Ala., 23.4 feet. The floods, however, were moderate, and no losses were reported except of a few cattle that had strayed back to the river after having been driven out of the lowlands when warnings were received.

The same general conditions prevailed over the Black Warrior and lower Tombigbee drainage of Alabama, although in much more pronounced form below the mouth of the Black Warrior River. The crest stage at Demopolis, Ala., was 52.5 feet, 13.5 feet above the flood stage, at 5 p. m., February 22, but at Lock No. 10, Tuscaloosa, Ala., the highest stage was 0.3 foot below the flood stage of 46 feet. Impounding of water behind the dam at Lock No. 17, 25 miles above, probably prevented a further rise of 6 or 8 feet at Tuscaloosa, and of a foot or two more at Demopolis. Lowlands for a distance of 175 miles below Demopolis were inundated, but the losses were only about \$10,000, as a greater flood had occurred during January and after that flood there was little property subject to damage left in the river bottoms. Property valued at \$4,000 was saved by the warnings.

Floods in the Pascagoula and Pearl systems of Mississippi and Louisiana were also moderate as a rule. The weather had been dry for several months; otherwise the amount of rain that fell from February 12 to 14 and on February 18 and 19 would have produced a much greater flood. The Lower Pearl and West Pearl Rivers were still in flood at the close of the month. Loss and damage as reported was \$65,900, while the reported value of property saved through the warnings was \$40,700. The loss to farmers was negligible.

*Ohio drainage.*—The January floods in the Wabash and White Rivers of Indiana continued during the early days of February, an ice gorge in the Wabash below Covington, Ind., causing a stage at Covington of 24 feet, or 8 feet above the flood stage, on February 1. There was a slight additional swell caused by the rains of February 5, but nothing more, and no damage was reported except that given in the MONTHLY WEATHER REVIEW for January, 1927.

The Green River of Kentucky was generally in flood from about January 22, and it was not until February 10 that the flood waters subsided over the lower reaches. The crest stages were from 12 to 14 feet above the flood stages, with a maximum at Lock No. 4, Woodbury, Ky. Warnings were widely distributed before and during the high water, and the total of reported losses was small. The American Red Cross contributed effectively to relief work along the middle reaches of Green River.

Heavy rains over the upper Tennessee River drainage on February 22 and 23 caused a decided rise in all upper tributaries and the upper river, with moderate flood stages in several of the former and at Rockwood, Tenn., on the latter. No damage was reported. At the end of

the month the crest of this rise had just reached Guntersville, Ala.

*Ohio River.*—The Ohio River passed below the flood stage of 28 feet at Louisville, Ky., on February 1, and at Cloverport, Ky., during February 4, but not until 10:30 p. m., February 9, at Evansville, Ind., and during the night of February 14 at Cairo, Ill. At Evansville a crest of 44.8 feet was reached on January 30, and at Cairo a crest of 48.9 feet on February 6 and 7. These latter dates marked the end of the flood that began at Pittsburgh, Pa., on January 21. During this flood the Cumberland and Tennessee Rivers were not in flood, but the Ohio above the mouth of the Cumberland was much higher than in late December and early January. The upper Mississippi was also low.

This flood did not differ much from other great Ohio River floods, except in the remarkable smallness of the loss and damage. In the Evansville district, direct Ohio River losses were \$69,940, and in the Cairo district, \$48,950, of which \$39,250 was in crops, mostly in the State of Kentucky. Reported savings through flood warnings were between \$50,000 and \$100,000 in the Evansville district and \$77,000 in the Cairo district. About 23,000 acres of land were overflowed in Illinois and 15,000 acres in Kentucky.

*Lower Mississippi River.*—The flood in the lower Mississippi River was virtually continuous throughout the month. The river at New Madrid, Mo., reached the flood stage of 34 feet on February 1, a crest of 37.6 feet on February 8, and had fallen only to 29.3 feet on February 26, when another and greater rise set in. Report on this flood must be further delayed, as the river did not reach the flood stage of 17 feet at New Orleans until February 13, and was still rising at the end of the month. The Yazoo River of Mississippi remained high throughout the month, and the Atchafalaya and Ouachita Rivers of Louisiana moderately so.

*Illinois River.*—Heavy rains and melting snows around February 4 and 5 caused another marked flood in the Illinois River with crests from 4.5 to about 8 feet above the flood stages. A full river when the rains began and a low Mississippi River balanced one another and the rise was about normal for the amount of rain and melted snow. Warnings were issued for 10 days, and below Peoria the river was still in flood at the close of the month.

*White and Black Rivers of Arkansas.*—The floods in these rivers began about January 22 and were due to a series of heavy rains from January 19 to 26. While the floods were not severe, several thousand acres of farm land were overflowed in the territory back of White River Levee and about 1,000 residents were driven from their homes for two weeks or more. The levee broke in a few places, but the greater portion stood. Most of the stock and portable property had been removed as soon as the first warnings were received. The lower St. Francis River of Arkansas was also somewhat above flood stage during the greater portion of the month, as was also the Arkansas River near its mouth, mainly on account of the flood in the Mississippi River.

*Colorado River and tributaries.*—Precipitation from February 11 to 17 was heavy at times over northern and central Arizona and rises unusual for the season occurred in the lower Colorado and the Gila Rivers. While flood stages were not reached in the Colorado, the situation was such as to necessitate warnings. River conditions in the lower valley were precarious, the people were much alarmed, and the warnings proved of great value. There

was no damage. In the Gila and Salt and other tributary streams flood conditions prevailed, with a crest of 10 feet, 5 feet above the flood stage, in the Salt River at Phoenix, Ariz., on February 17. Warnings were issued for the lower districts, but little could be done to protect crops. Losses reported were \$11,800. The heaviest rains occurred over a limited area in the central portion of the State, and at Prescott the rainfall was the greatest recorded in any one month since 1866.

*Pacific drainage—Sacramento system.*—Five days of excessive rains within a week over the upper drainage of the Sacramento River of California could have but one sequence, and the only question was of the intensity of the flood. At Kennett, the total rainfall from February 14 to 20, inclusive, was 13.15 inches, of which all but 0.45 inch fell in five days which, however, were not consecutive. At Red Bluff, 73 miles below Kennett, the rainfall during the same period was 4.44 inches, and somewhat less farther south. There were also heavy rains over the tributary mountain drainage to the eastward.

By February 18 it was apparent that a flood was imminent, and warnings were issued for the Sacramento and for the mountain tributaries. Late afternoon reports on February 20 indicated that heavy rains were falling upon the snows over the high altitudes to the north and on the soft snow in the Sacramento Canyon, and additional warnings were issued at once. The heavy rains continued to fall, and on the morning of February 21 general warnings were issued for the Sacramento River as far south as the mouth of the American River. Thirty gates of the Sacramento Weir were opened during the day, permitting a vast quantity of water to flow into Yolo Basin, and at the same time Fremont Weir, near the mouth of Feather River, was discharging into the basin large volumes of excess water from the Feather-Yuba and Bear Rivers. Then began a spectacular fight by the farmers below to save their lands. Their efforts were only partially successful, and within two days, more than 15,000 acres of lands had been flooded. One large tract of 6,000 acres was protected by sandbags on top of a 4-mile levee, and the water crested within four inches of the top of the double line of bags. A break in the levee two miles above Colusa on the Sacramento River was the only break reported, and several thousand acres of orchards were overflowed.

Warnings were frequently issued and they covered all sections affected. At Sacramento the situation was much relieved by the opening of the gates of the weir. Reports of losses were very incomplete, but those reported aggregated \$275,000, of which \$60,000 was in crops. The value of property saved through the warnings was given as \$135,000. Many expressions of commendation for the service rendered by the Weather Bureau were received, and among them letters from the managers of the reclamation and levee districts, who were enabled to combat successfully with the flood waters.

*Willamette system.*—There were two floods in the system. The first, during the early days of the month, was unimportant, but the second was more pronounced and caused much damage.

The second flood was caused by the same series of general and heavy rains that caused floods in California. In Oregon the season had been unusually wet, and when the rains began on February 15 they fell upon soil well saturated, with deep snow in the mountains and some snow in the foothills. The heaviest rains fell on Feb-

ruary 19 and 20, and on the morning of the latter date the first warnings were issued for the Santiam River and a few hours later for the Willamette and tributaries as far down as Eugene, Oreg. On February 21 warnings covered the lower river, with 18 feet, or 3 feet above flood stage, forecast for Portland. The actual crest was 18.1 feet on February 24. The breaking of a dyke in the Santiam River, 1 mile above Jefferson, Oreg., probably lowered the crest at Jefferson about 1 foot. There were also floods at the same time in the Rogue and Umpqua Rivers of southern Oregon, as well as in smaller streams. No service is maintained on these rivers.

Losses of \$386,505 were reported, not including losses due to suspension of business. The reported value of property saved by the warnings was \$161,000. Information as to the latter item was, as usual, very incomplete. Expressions of appreciation for the service rendered were numerous.

River and station	Flood stage	Above flood stages (dates)		Crest	
		From—	To—	Stage	Date
ATLANTIC DRAINAGE					
James:	Feet			Feet	
Columbia, Va.....	18	Feb. 20	Feb. 21	21.0	Feb. 20
Richmond, Va.....	10			10.0	21
Roanoke:					
Randolph, Va.....	21	21	21	23.3	21
Weldon, N. C.....	30	21	23	36.6	22
Pee Dee:					
Cheraw, S. C.....	27	25	25	27.0	25
Mars Bluff, S. C.....	17	27	(1)	17.5	28
Santee:					
Rimini, S. C.....	12	23	(1)	13.6	28
Ferguson, S. C.....	12	25	(1)	12.8	28
Broad: Blairs, S. C.....	15	24	26	15.4	24
Saluda:					
Pelzer, S. C.....	7	24	24	8.4	24
Chappells, S. C.....	14	20	20	14.7	20
EAST GULF DRAINAGE					
Alabama: Selma, Ala.....	35	16	21	37.8	17
Etowah: Canton, Ga.....	11	14	14	13.9	14
Cahaba: Centerville, Ala.....	25	14	14	27.0	14
Tombigbee: Lock No. 4, Demopolis, Ala.....	39	14	Mar. 1	52.5	22-23
Pascagoula: Merrill, Miss.....	20	17	Feb. 24	21.2	20
Chickasawhay:					
Enterprise, Miss.....	21	15	15	21.6	15
Shubuta, Miss.....	27	14	22	30.1	19
Leaf: Hattiesburg, Miss.....	19	14	16	20.0	15
Pearl:					
Edinburgh, Miss.....	21	19	22	22.0	21
Jackson, Miss.....	20	16	(1)	30.0	23-24
Monticello, Miss.....	18	14	16	19.6	15
Columbia, Miss.....	18	14	28	21.2	16
Bogue Chitto: Franklinton, La.....	16	14	15	17.3	14
West Pearl: Pearl River, La.....	13	16	(1)	16.4	18
GREAT LAKES DRAINAGE					
St. Joseph: Montpelier, Ohio.....	10		9	10.8	8
MISSISSIPPI DRAINAGE					
Ohio:					
Louisville, Ky.....	28	(2)	1	35.6	Jan. 27
Dam 41, Ky.....	51	(2)	1	58.7	27
Dam No. 44, Leavenworth, Ind.....	48	(2)	3	60.1	27
Cloverport, Ky.....	40	(2)	4	49.1	28
Evansville, Ind.....	35	(2)	9	44.8	29-30
Dam No. 48, Cypress, Ind.....	35	(2)	9	37.3	Mar. 2
Mount Vernon, Ind.....	35	(2)	11	44.7	Jan. 31
				45.4	Jan. 31-
					Feb. 1
Shawneetown, Ill.....	35	(2)	15	47.9	Feb. 2
Paducah, Ky.....	43	3	9	44.2	6
Cairo, Ill.....	45	1	13	48.9	7
				9.4	7
Tuscarawas: Gnadenhutten, Ohio.....	9	6	28	10.2	26
Scioto: Larue, Ohio.....	11	6	6	11.1	6
Green:					
Lock No. 4, Woodbury, Ky.....	33	(4)	1	46.8	Jan. 25
Lock No. 2, Rumsey, Ky.....	34	(3)	12	43.2	Feb. 1-2
Wabash:					
Lafayette, Ind.....	11	(2)	10	21.9	Jan. 31
Covington, Ind.....	16	(2)	11	24.0	Feb. 1
Terre Haute, Ind.....	16	3	12	18.6	6
Vincennes, Ind.....	14	7	17	16.8	11
Mount Carmel, Ill.....	16	(2)	18	19.6	2
				6.4	1-2
Tippecanoe: Norway, Ind.....	6	(2)	9	12	10
				24	15-16
White: Decker, Ind.....	18	(2)	3	22.3	Jan. 28
White, West Fork:					
Elliston, Ind.....	19	2	4	20.0	Feb. 2-
				19.3	3
Edwardsport, Ind.....	15	1	11	17.3	4

<sup>1</sup> Continued at end of month.<sup>2</sup> Estimated.<sup>3</sup> Continued from last month.<sup>4</sup> Ice gorge below station.

River and station	Flood stage	Above flood stages (dates)		Crest	
		From—	To—	Stage	Date
MISSISSIPPI DRAINAGE—continued					
Tennessee:	<i>Feet</i>			<i>Feet</i>	
Rockwood, Tenn.....	20	25	26	21.2	25
Widows Bar Dam, Ala.....	26	25	(1)	29.7	27
French Broad: Dandridge, Tenn.....	12	24	24	13.0	24
Big Pigeon: Newport, Tenn.....	6	23	23	8.4	23
Holston: Rogersville, Tenn.....	14	24	24	19.0	24
Holston, North Fork: Mendota, Va.....	8	23	24	10.1	24
Clinch: Clinton, Tenn.....	25	25	25	25.4	25
Mississippi:					
New Madrid, Mo.....	34	1	16	37.6	8
Memphis, Tenn.....	35	5	20	37.8	12-13
Helena, Ark.....	44	7	24	47.3	15
Arkansas City, Ark.....	48	6	28	51.8	17-19
Greenville, Miss.....	42	8	28	44.8	17-20
Vicksburg, Miss.....	45	6	(1)	49.5	21-24
Natchez, Miss.....	46	12	(1)	49.5	23-27
Angola, La.....	45	13	(1)	48.1	25-28
Baton Rouge, La.....	35	12	(1)	39.0	28
Donaldsonville, La.....	28	12	(1)	30.9	26-28
New Orleans, La.....	17	13	(1)	18.5	25-28
Illinois:					
Morris, Ill.....	13	3	11	20.0	6
Peru, Ill.....	14	1	(1)	22.1	7
Henry, Ill.....	10	4	(1)	16.1	9
Peoria, Ill.....	18	5	27	22.6	10
Havana, Ill.....	14	4	(1)	18.5	14
Beardstown, Ill.....	14	4	(1)	20.0	15
Pearl, Ill.....	12	5	(1)	16.2	16
St. Francis: Marked Tree, Ark.....	17	1	20	18.6	7-11
Arkansas: Yancopin, Ark.....	29	(2)	(1)	38.2	15-19
White:					
Newport, Ark.....	26	(3)	4	32.6	Jan. 26
Georgetown, Ark.....	22	(3)	14	28.9	30
Clarendon, Ark.....	30	(3)	13	32.6	Feb. 4-5
Black:					
Corning, Ark.....	11	(3)	16	15.0	Jan. 26-28
Black Rock, Ark.....	14	(3)	14	26.3	23
Cache: Patterson, Ark.....	9	(3)	15	11.2	Feb. 6-7
Yazoo: Yazoo City, Miss.....	25	(3)	(1)	30.4	Jan. 21
Tallahatchie: Swan Lake, Miss.....	25	(3)	28	31.1	7-9
Sulphur: Finley, Tex.....	24	(3)	1	24.4	Jan. 31
Ouachita: Camden, Ark.....	30	Jan. 25	2	33.8	Jan. 29
Atchafalaya: Melville, La.....	37	Feb. 14	(1)	39.0	Feb. 28
Little: Little River, Tex.....	30	9	10	35.5	Feb. 10
PACIFIC DRAINAGE					
Gila:					
Kelvin, Ariz.....	5	15	16	6.8	15
Gila Bend, Ariz.....	5	17	18	5.7	18
Salt: Phoenix, Ariz.....	5	16	18	10.0	17
Sacramento:					
Red Bluff, Calif.....	23	21	21	26.5	21
Knights Landing, Calif.....	18	18	26	19.8	22
Yuba: Colgate, Calif.....	14	21	21	14.2	21
Willamette:					
Eugene, Oreg.....	12	20	22	17.0	21
Albany, Oreg.....	20	21	24	29.2	22
Salem, Oreg.....	20	22	24	24.9	23
Oregon City, Oreg.....	12	22	26	15.6	24
Portland, Oreg.....	15	23	26	18.1	24
Willamette, Coast Fork: Saginaw, Oreg.....	9	20	22	12.2	21
Willamette, Middle Fork: Eula, Oreg.....	13	21	21	17.0	21
Santiam: Jefferson, Oreg.....	10	2	2	10.3	2
North Santiam: Mehama, Oreg.....	15	21	21	15.0	21

<sup>1</sup> Continued at end of month.<sup>2</sup> Continued from last month.

## MEAN LAKE LEVELS DURING FEBRUARY, 1927

BY UNITED STATES LAKE SURVEY

[Detroit, Mich., March 4, 1927]

The following data are reported in the Notice to Mariners of the above date:

Data	Lakes <sup>1</sup>			
	Superior	Michigan and Huron	Erie	Ontario
Mean level during February, 1927:				
Above mean sea level at New York.....	601.32	578.25	570.97	245.31
Above or below.....				
Mean stage of January, 1927.....	-0.12	+0.05	-0.16	+0.03
Mean stage of February, 1926.....	+1.08	+0.83	+1.07	+1.21
Average stage for February, last 10 years.....	-0.19	-1.15	-0.19	+0.31
Highest recorded February stage.....	-1.16	-4.47	-2.78	-2.36
Lowest recorded February stage.....	+1.08	+0.83	+1.07	+1.48
Average departure (since 1860) of the February level from the January level.....	-0.20	+0.03	-0.08	+0.07

<sup>1</sup> Lake St. Clair's level: In February, 1927, 572.40 feet.